13

and includes the training or 'learned' information which was extracted from an example database constructed as described in (a) through (f) hereinbefore. The final processing unit 108 produces an output corresponding to the alertness state of the subject from which the physiological, eye tracking, video, performance and other alertness-related data were taken.

Additional disclosure related to the invention is included in Appendix A, entitled "Diploma Thesis: Development of an Automatic System to Detect Microsleeps in EEG based on Artificial Neural Networks."

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of the equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A method of detecting and indicating at least one occurrence of a microsleep event experienced by a subject, comprising the steps of:

training a neural network to detect said occurrence, said neural network having an input for receiving data, correlated to the occurrence and non-occurrence of microsleep events, from at least one descriptive data source, and an output representing an alertness level result indicating whether a microsleep event has occurred; and,

applying a plurality of input feature vectors derived from data received from said descriptive data source to said neural network input, each of said input feature vectors includes data elements corresponding to at least one set of physiological, behavioral or performance data relating to at least one aspect of said subject's alertness state, so as to produce an alertness level result at said output.

2. A method according to claim 1, wherein said step of training a neural network includes the following substeps:

providing a plurality of example input feature vectors, selected to represent at elast one desired alertness level result; and,

applying each of said plurality of input feature vectors to said input of said neural network, and adjusting a plurality of neural network weights and biases, so as to minimize a difference between said alertness level result and said desired alertness level result.

3. A method according to claim 2, wherein each of said example input feature vectors is identified by one or more observed fatigue related events.

4. A method according to claim 3, wherein said fatigue related event includes at least one of the following: head snapping, multiple blinks, blank stares, wide eyes, yawning, and partial and complete prolonged eyelid closures, partial and complete eye movements and combinations thereof.

5. A method according to claim 1, wherein said step of applying a plurality of input feature vectors further includes the step of applying data from said plurality of descriptive data sources sequentially, one vector at a time.

6. A method according to claim 1, wherein said step of applying a plurality of input feature vectors further includes the step of applying data from at least two of said plurality of descriptive data sources in parallel.

7. A method according to claim 1, wherein said alertness level result is indicitave of the occurrence of both microsleep events and non-microsleep events.

14

8. A method according to claim 7, wherein said alertness level result is further representative of the alertness state of the subject.

9. A method according to claim 8, wherein said alertness level result can indicate at least one type of transitional event in said alertness state.

10. A method according to claim 9, wherein the type of transitional event includes any one of the following types: microsleep-to-non-microsleep, microsleep-to-sleep-stage-1, and microsleep-to-sleepstage-2.

11. A method according to claim 1, wherein said physiological, behavioral or performance criteria include at least one of the following: EEG data, EOG data, EMG data, ECG data, eye blinking characteristics, eye tracking data, EDA data, blood pressure data, respiration data, facial expression data, and specific performance data, video data and combinations thereof.

12. A method according to claim 11, wherein data elements corresponding to said physiological, behavioral or performance criteria are transformed by at least one operation including determing the mean, median, variance, total power, discrete frequency power, average frequency, coefficients of autoregressive models, correlation dimension, mutual dimension, Lyapunov exponent, entropy and combinations thereof, so as to provide additional feature vectors to said neural network input.

13. An apparatus for detecting and indicating at least one occurrence of a microsleep event experienced by a subject, comprising:

a neural network trained to detect said occurrence, said neural network having an input for receiving data correlated to the occurrence and non-occurrence of microsleep events, from at least one descriptive data source, and an output representing an alertness level result indicating whether a microsleep event has occurred; and,

means for receiving a plurality of input feature vectors derived from data received from said descriptive data source to said neural network input, wherein each of said input feature vectors includes data elements corresponding to at least one set of physiological, behavioral or performance criteria relating to at least one aspect of said subject's alertness state, so as to produce an alertness level result at said output.

14. An apparatus according to claim 13, wherein said alertness level result is indicative of the occurrence of both microsleep events and non-microsleep events.

15. An apparatus according to claim 14, wherein said alertness level result is further representative of the alertness state of said subject.

16. An apparatus according to claim 15, wherein said alertness level result can indicate at least one type of transitional event in said alertness states.

17. An apparatus according to claim 16, wherein the types of said transitional event include any one of the following: microsleep-to-non-microsleep, microsleep-to-sleep-stage-1, and microsleep-to-sleepstage-2.

18. An apparatus according to claim 13, wherein said data elements corresponding to said at least one set of physiological, behavioral or performance criteria include at least one of the following EEG data, EOG data, EMG data, ECG data, eye blinking characteristics, eye tracking data, EDA data, blood pressure data, respiration data, facial expression data, and specific performance data, and combinations thereof.

19. An apparatus according to claim 18, wherein prior to being provided to said neural network, the data elements corresponding to said at least one set of physiological, behavioral or performance criterial are transformed by at least one including determining the mean, median, variance,